Fluid Mechanics HW
Group 1

Brady
seminar
1/15/24

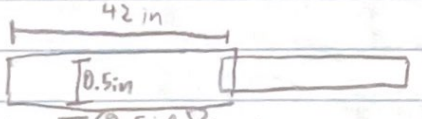
1.48.) $F = 18000\ lb$ (25) $A = \pi r^2$ $r = 1.25\ in$
$D = 2.5\ in$ $A = \pi(1.25\ in)^2 = 4.91\ in^2$
$P = \frac{F}{A} = \frac{18000\ lb}{4.91\ in^2} = \boxed{3665.99\ lb/in^2}$

1.58.) $E = \frac{-\Delta P}{\Delta V / V}$ $E_{mercury} = 3590000\ psi = 24750\ MPa$

$3590000\ psi \cdot 0.01 = -\Delta P = \boxed{-35900\ psi = \Delta P}$

$24750\ MPa \cdot 0.01 = -\Delta P = \boxed{-247.5\ MPa = \Delta P}$

1.63.) $D = 0.5\ in$ $l = 42.0\ in$ machine oil



Assuming $\frac{\Delta V}{V} = 0.01 \Rightarrow E = 189000\ psi$

$V = \frac{\pi(0.5\ in)^2}{4} \cdot 42.0\ in = 8.247\ in^3$

$\Delta V = V - V_x$ $V_x = \frac{\pi(0.5\ in)^2}{4} \cdot x$ $-\frac{\Delta V}{V} = \frac{V - V_x}{V}$

$-\left(\frac{\Delta V}{V} \cdot V - V\right) = \frac{-\pi(0.5\ in)^2}{4} \cdot x \Rightarrow x = -\left(\frac{\Delta V}{V} \cdot V - V\right) \cdot -\frac{4}{\pi(0.5\ in)^2}$

$x = -(-0.01 \cdot 8.247\ in^3 - 8.247\ in^3) \cdot -\frac{4}{\pi(0.5\ in)^2} \Rightarrow x = 41.58\ in$

$\Delta L = h - x$

$E = -\frac{\Delta P}{\frac{\Delta V}{V}} \Rightarrow -E \cdot \frac{\Delta V}{V} = \Delta P = 189000\ psi \cdot -0.01 = 1890\ psi$

$\Delta P \cdot A = 1890\ psi \cdot \frac{\pi(0.5\ in)^2}{4} = 371.1\ lb$

$C = \frac{F}{\Delta L} = \frac{371.1\ lb}{42.0\ in - 41.58\ in} = \boxed{883.57\ \frac{lb}{in}}$

1.76.) $w = mg = 1\ lb$ $m = \frac{W}{g} = \frac{1\ lb}{32.2\ ft/s^2} = \boxed{0.0311\ slugs}$

$1\ lb\left(\frac{0.4536\ kg}{1\ lb}\right) = \boxed{0.4536\ kg}$

$1\ lb = \boxed{4.45\ N}$

1.92.)

$V = \pi r^2 \cdot h$

$V = \pi (0.075 m^2) \cdot (0.2 m)$

$V = 0.00353 \ m^3$

$W = 35.4 N - 2.25 N = 33.15 N$

$\gamma_{oil} = \frac{33.15 N}{0.00353 m^3} = 9390.93 \frac{N}{m^3}$

$Sg = \frac{9390.93 \frac{N}{m^3}}{9810 \frac{N}{m^3}} = \boxed{0.957}$ $\quad \gamma_{H_2O @ 4°C} = 9810 \frac{N}{m^3}$

1.107.) $Sg = 0.79 \ \therefore \ \rho_o = 790 \frac{kg}{m^3} \left(\frac{1000 g}{1 kg}\right)\left(\frac{1 m^3}{1000000 cm^3}\right)$

$= \boxed{0.79 \frac{g}{cm^3}}$

$790 \frac{kg}{m^3} \left(\frac{1 m^3}{35.31 ft^3}\right)\left(\frac{1 slug}{14.59 kg}\right) = \boxed{1.53 \frac{slugs}{ft^3}}$